

Statistical Analysis of Weigh-in-Motion Data: Application to Bridge Reliability Analysis

Nathan Tirk

College of Engineering and Mathematical Sciences

School of Engineering

ABSTRACT

Multiple types of loads need to be considered when designing a bridge. From the point of view of functionality, the most important one is the live load, i.e. gravity loads induced by traffic. Live loads vary randomly as a function of space and time. Using data gathered from weigh-in-motion stations located across the state of Vermont during the last 13 years, we conducted a statistical analysis of the live loads experienced by existing bridges. The data includes time of events, truck axle weight and spacing. This data, combined with structural analysis algorithms, provides an estimate of the maximum stress demands that would have been produced by each truck if passed over a bridge of a given length and type. These results were compared to the values recommended by current bridge design specifications. The goals of this project are: (i) to verify that the live loads used in current bridge design specifications are consistent with low-probability events as reflected by the statistical analysis of the weigh-in-motion stations and (ii) to propose a new stochastic model consistent with the observed live loads. This new model can be used to perform explicit reliability calculations for complex bridge structures.